⚠Please read this manual carefully before operation.

⚠ O_2 sensor contains corrosive. NO sensor contains acid. Avoid contact with skin, eyes and clothes. In case of contact, flush with water for at least 15 minutes. In case of urgency, please go to hospital for assistance immediately.

⚠Before the instrument is switched on, do not touch the internal running ventilation fan to avoid being clamped.

⚠ Always protect the power supply by properly grounding the instrument. A high-quality power filter/surge protector is recommended.

⚠Do not power off the instrument when the pumped is still on.

⚠Power off the instrument during maintenance.

⚠Check the water filter frequently. Clean the filter bowl when it becomes full of water or debris. Failure to clean or replace filters results （see 6.2.2） in water damage to sensitive analyzer components. Water damage to the instrument voids your warranty.

⚠Before the work is ended every day, switch on the pump for a few minutes（see 4.8）to flow out the residual gases，then switch off the pump and return to the main menu, finally switch off the instrument.

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1 Introduction

BulletPro 502 Gas Analyzer is for measuring CO, HC and CO_2 in automotive emissions by the principle of non-dividing infrared absorption, measuring NO and O_2 by the principle of electrochemical cell, calculating excessive air coefficient λ based on the composition of CO, CO_2, HC and O_2 measured. This instrument is equipped with gas bench with self-owned intellectual property right, microprocessor is embedded. It is an intellectual instrument with liquid crystal display and Chinese or English interface. Inductive RPM (engine-speed) measuring pliers, oil temperature sensor and printer are optional for measuring RPM and oil temperature, and printing measurement results.

This instrument complies with the requirements of International Measurement Rules OIML R99/1998 (E) made by the Organization of International Measurement Law (OIML) and the National Metrological Verification Regulations # JJG 688 for class-1 instruments. It is applicable for environmental departments, vehicle inspection stations, automotive manufacturing factories and garages.

2 Technical Specification

Operation Condition			
Temperature		+5℃ to +40℃	
Relative humidity		5% to 95%non-condensing	
Atmospheric pressure		70 kPa to 106 kPa	
Power supply			
Voltage		AC220V±15%	
Frequency		50Hz ±1Hz	
Measurement Range			
HC (Hexane Equivalent)		0ppm to 10000ppm	
CO		0% to 10%	
CO_2		0% to 20%	
O_2		0% to 25%	
NO (Not for NHA-406)		0ppm to 5000ppm	
RPM		300rpm to 8000rpm	
Oil Temperature		0℃ to +120℃	
Resolution			
HC		1ppm	
CO		0.01%	
CO_2		0.01%	
O_2		0.01%	
NO (Not for NHA-406)		1ppm	
RPM		10rpm	
Oil Temperature		1℃	
Indication Error		**Absolute**	**Relative**
HC	0ppm to 2000ppm	±12 ppm	±5%
	2001ppm to 10000ppm	-	±10%
CO		±0.06%	±5%
CO_2		±0.5%	±5%
O_2		±0.1%	±5%
NO (Not for NHA-406)		±25ppm	±4%
Others			
Warm-up Time		10 minutes	
Output Interface		RS-232C	
Outer Dimension		(L)450mm(W)260mm(H)180mm	
Net Weight		7kg	

3 Description of the Unit

3.1 Composition

As shown in Fig. 3-1，the instrument is composed of the instrument host, short tube, pre-filter, sampling pipe, sampling probe and embedded micro printer (optional).

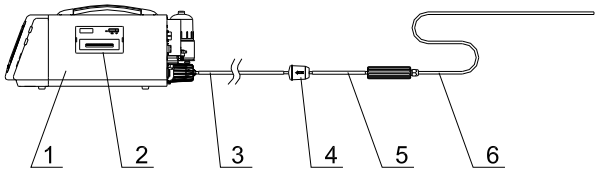

Fig. 3-1 Composition of the Unit

●1—Instrument host ： control measurement and analyze emissions components；

●2—Embedded micro printer (optional)；

●3—Sampling pipe (5m) ： connect pre-filter and sample gas inlet；

●4—Pre-filter: pre-filter sample gases；

●5—Short tube：connect pre-filter and sampling probe；

●6—Sampling probe ： sample vehicle emissions.

3.2 Front Panel

Fig. 3-2 shows the layout of the front panel. Names and functions of all the parts on front panel:

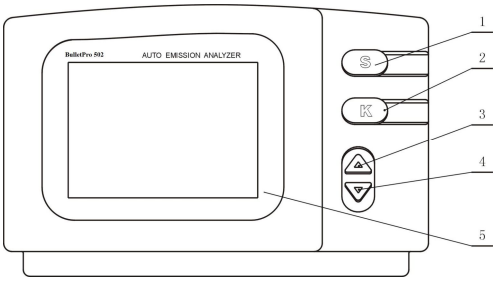

Fig. 3-2 Layout of Front Panel

●5—Liquid crystal display: display menus and measurement data；

●1—“**S**” key：corresponding to the functional sub-menu at the lower part of LCD, execute the corresponding operation；

●2—“**K**” key ： corresponding to the functional sub-menu at the lower part of LCD, execute the corresponding operation；

●3— “▲” key：move the cursor on LCD upward and select the required item； corresponding to the functional sub-menu at the lower part of LCD, execute the corresponding operation；

●4— “▼” key：move the cursor on LCD downward and select the required item； corresponding to the functional sub-menu at the lower part of LCD, execute the corresponding operation.

3.3 Rear Panel

Fig. 3-3 shows the layout of the rear panel. Names and functions of all the parts on rear panel:

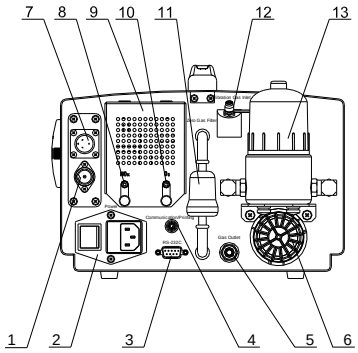

Fig. 3-3 Layout of Rear Panel

●1—Oil temperature signal socket: input signal of oil temperature sensor；

●2—Mains socket and switch: the socket is for 220V AC power input, and the switch is for power on / off, with built-in 1A fuse and filter for mains noise；

●3—RS-232C socket：for communication with external computer；

●4—“COM/Printing” Selector ： switch

between “Printing” and “COM”.

●5—Gas outlet：main outlet for sample gas after measurement；

●6—Condenser and sample gas inlet：connect outlet of pre-filter via short tube, to introduce sample gas. Condenser can lower sample gas temperature to prevent condensation in sampling system；

●7—RPM signal socket: input signal of RPM measuring pliers or RPM adaptor；

●8—Outlet of NO sensor；

●9—Sensor cap: for protection of NO sensor and O2 sensor;

●10—Outlet of O2 sensor；

●11—Zero gas filter：filter the dust in air；

●12—Calibration gas inlet: used as inlet of standard gas, with pressure of approx. 0.02 MPa；

●13—Water filter: separate oil, dust and water in sample gas, replace the internal big / small filter elements as required.

4 Operation

4.1 Preparation

4.1.1 Installation

a) As shown in Fig. 3-1，firstly connect one end of the short tube with the end of the sampling probe, and the other end of short tube with inlet of the pre-filter. Then, connect one end of the 5-meter sampling pipe with outlet of the pre-filter, and the other end of sampling pipe with the sampling gas inlet. Noted that pre-filter should be connected as per shown in Fig. 3-1, check all connections and make sure that they are firmly connected without any leakage.

b) Make sure that clean filter elements are mounted in pre-filter and water filter respectively.

c) Respectively connect power cable, oil temperature sensor and RPM measuring pliers to the mains socket, oil temperature signal socket and RPM signal socket.

d) Insert the oil temperature sensor into the hole of engine oil dipstick, clamp the RPM measuring pliers on the high tension cable of spark plug of 1st cylinder（Fig. 4-1-1）.

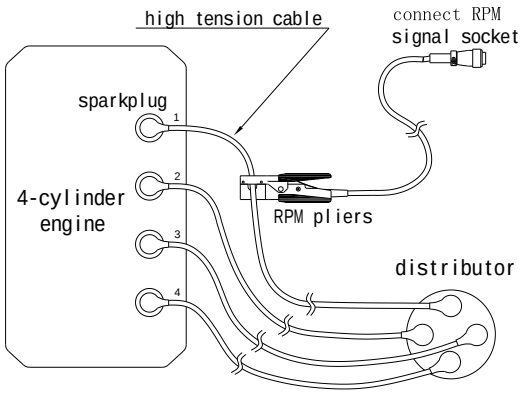

Fig. 4-1-1 Installation of RPM Pliers

4.1.2 Warm-up

Insert power cable into 220V AC mains socket, power on and warm up the instrument. "**Warming Up!"** and "**Please Wait for xxx seconds**" appear. "**xxx seconds**" is the warm-up time remained by count-down. The total warm-up time is 600 seconds (10 min.). See Fig. 4-1-2.

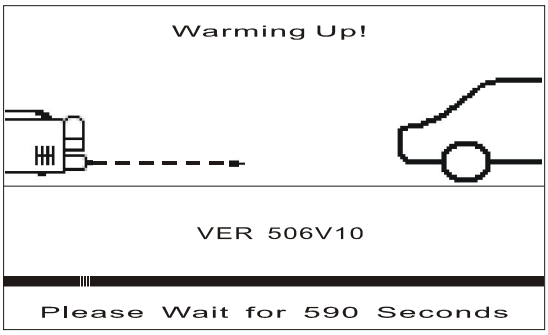

Fig. 4-1-2 Warm-up after Power-on

⚠Warm-up time of 600 seconds is only for the case when the instrument is operated at ambient temperature of approx. 20℃. If ambient temperature is much higher than 20℃, the warm-up time may be shorter. If ambient temperature is much lower than 20℃, the warm-up time will be longer. The warm-up will be automatically ended as long as the technical requirements are reached.

4.1.3 Leak Check

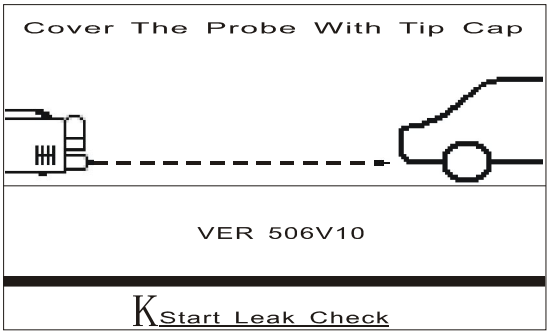

Fig. 4-1-3 Waiting for Leak Check

The instrument automatically enters the interface of Leak Check after warm-up, to check the sampling system for leakage. At this time, a prompt appears on the upper part of the display as "**Cover The Probe With Tip Cap**" and "**KStart Leak Check**" appears at the lower part of the display (see Fig. 4-1-3). User shall operate as per the prompts, press [K] to start leak check. Then, "**Leak Checking .....**" and "**Please Wait for xx seconds**" appear (Fig. 4-1-4). "**XX sec.**" is the leak checking time remained (by count-down, totally 10 seconds).

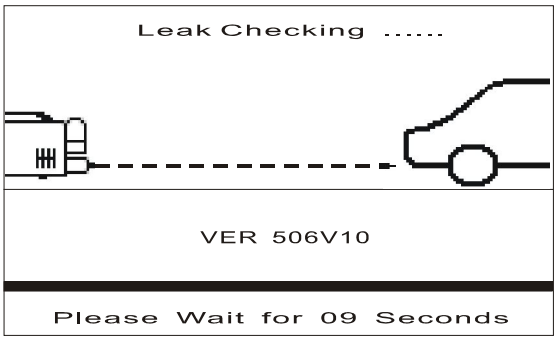

Fig 4-1-4 Leak Checking

After leak check, if leakage is detected, a prompt appears as "**Leakage, Please Check.....**" and "**KStart Leak Check Again**" (Fig.4-1-5). User shall check the sampling system carefully and eliminate any leakage (Fig. 6.4). If no leakage is detected, "**Leak Checking .....OK!**" appears (Fig. 4-1-6), and zeroing will be started automatically.

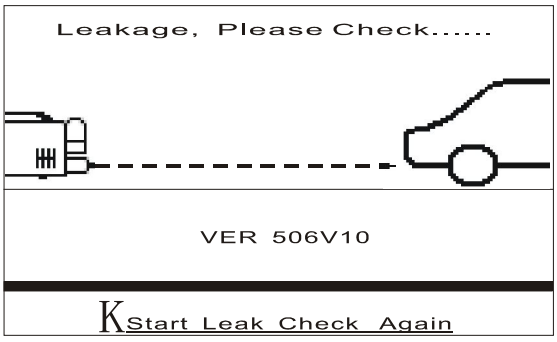

Fig 4-1-5 Leak Check Fails

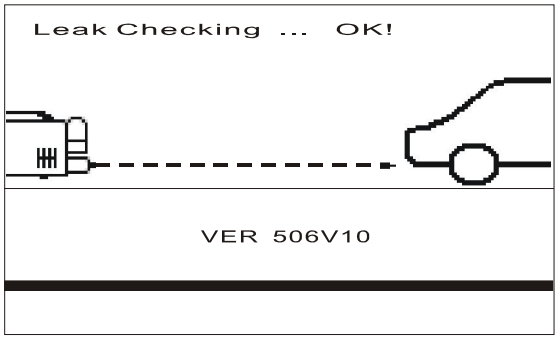

Fig 4-1-6 Leak Check OK

4.1.4 Auto Zeroing

When auto zeroing is started, a prompt appears as "**Zeroing...Please Wait!**" (Fig. 4-1-7). When zeroing is completed, "**Zeroing OK!**" appears (Fig. 4-1-8). The prompts disappear and the main menu is displayed in several seconds.

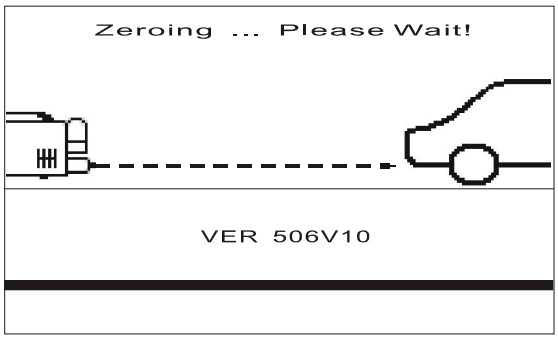

Fig 4-1-7 Zeroing

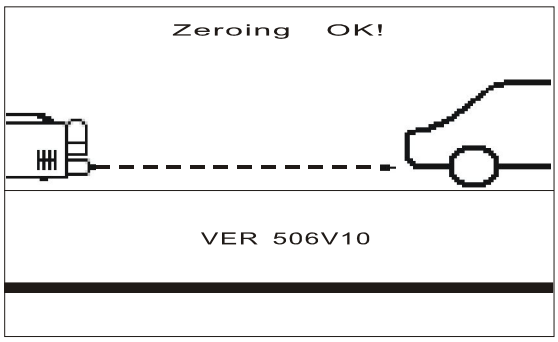

Fig 4-1-8 Zeroing OK

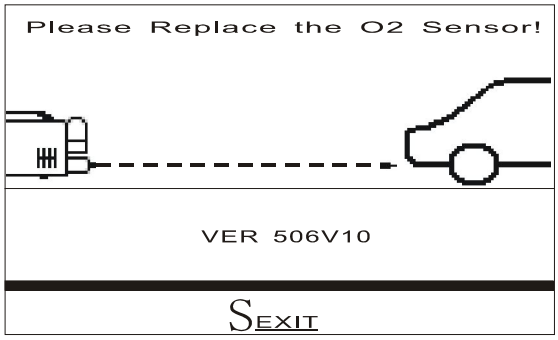

Fig 4-1-9 O2 Sensor is Aging

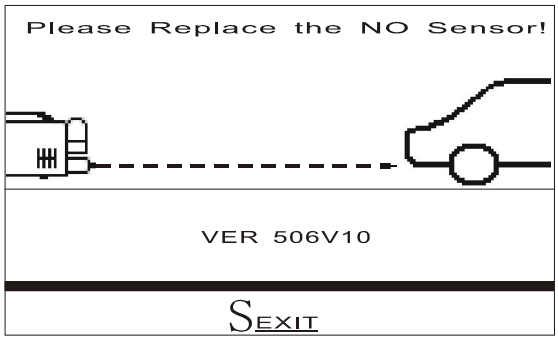

Fig 4-1-10 NO Sensor is Ageing

If the life time of NO sensor or O2 sensor is exceeded, there are prompts to remind user to replace sensor in time after auto zeroing, see Fig. 4-1-9 and 4-1-10. After NO sensor is replaced, operate as per instruction for "**New NO Sensor**" and re-calibrate it（refer to 4.7.4）.

4.2 Main Menu

The main menu is shown as in Fig. 4-2-1. The upper part is for name of the menu; the middle part is for displaying real-time data of HC, CO, CO_2, O_2, NO（Not for NHA-406）, n (RPM), λ (excessive air coefficient) or A/F, T (oil temperature) and PEF value, the lower part is for prompts.

Press [▲] or [▼] to move the menu forward or backward. There are six sub-menus: "**S**ZERO"、"**K**MEAS"、"**S**LEAK"、"**K**T CAL" 、"**S**SET" and "**K**GAS CAL". Press

[S] or [K] beside the sub-menu name to enter the corresponding sub-menu. Otherwise, return to the main menu from any sub-menu.

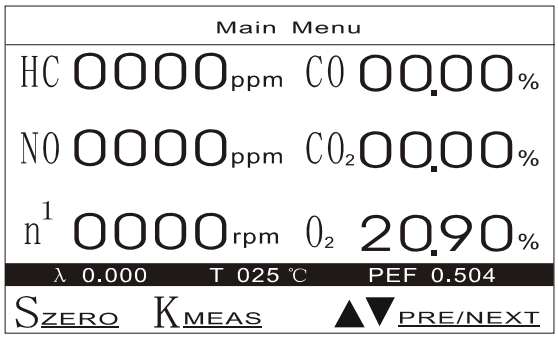

Fig 4-2-1 Main Menu

●**ZERO**—manual zeroing (see 4.3);

●**MEAS**—enter sub-menu "**Real-Time Measurement**" (see 4.8);

●**LEAK**—manual leak check (see 4.6);

●**T CAL**—enter sub-menu **"Oil Temperature Calibration**" (4.5);

●**SET**—enter sub-menu "**Setting Menu**"(see 4.7);

●**GAS CAL**—enter sub-menu **"Calibration With Gas"** (see4.4).

4.3 Zero

The instrument is with the function of auto zeroing. Zero is calibrated automatically and periodically (every half an hour). Usually zeroing is not required, it is performed only when user believes it necessary. In the main menu (see Fig. 4-2-1), press [▲] or [▼] and locate at sub-menu "**SZERO**", press [S] to start zeroing. A prompt "**Zeroing...Please Wait!**" appears on the upper part of the display. If zeroing is completed, "**Zeroing OK!**" is displayed. After several seconds, the prompts disappear and the main menu is returned (Fig. 4-2-1).

4.4 Calibration with Gas

The instrument may drift and the sensors may become ageing during service. Therefore, it is necessary to calibrate span after a period of service (generally 3-6 months). The O_2 sensor and NO sensor shall be replaced after service of approx. 1 year due to ageing (see 6.3). After NO is replaced, operate as per instruction for "New NO Sensor" (see 4.7.4) and re-calibrate the channel before being used. (Note：NO is not for NHA-406)

During calibration, if the deviation of data is very serious due to wrong operation and re-calibration is impossible, use option "Reset Default Cal. Values" (see 4.7.5) to reset the default values. (Note：calibration values for HC, CO, CO_2 channels can be reset, but not for O_2 channel and NO channel）.

4.4.1 Select Standard Gas

One-component and three-component standard gases are required for span calibration, the components are as follows,

a) Three-component standard gas

●CO：approx. 3.5 % vol;

●C_3H_8（Propane）: approx. 2000 ppm（0.2 %）vol;

●CO_2：approx. 14 % vol;

●N_2（Nitrogen）：residual value

b) One-component standard gas(not for NHA-406)

●NO：approx. 1000 ppm（0.1 %）vol;

●N_2（Nitrogen）：residual value

During calibration, the actual calibration values shall be subjected to the values on the tag on the standard gas cylinder,

without exceeding 15% of the above values.

⚠ NO calibration gas is excluded in accessories due to cylinder and validity problem. Please contact us for need of NO calibration gas.

4.4.2 Span Calibration for HC、CO and CO_2 Channels

Calibration steps are as follows:

a) Zeroing: calibrate zero as per 4.3 before calibration.

b) In the main menu（Fig. 4-2-1），press [▲] or [▼] to locate at "**K**GAS CAL", press [K] to enter the interface as shown in Fig. 4-4-1.

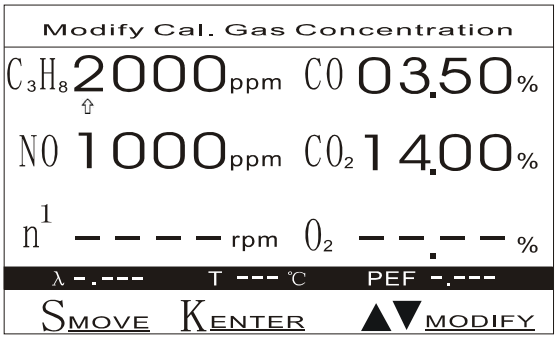

Fig 4-4-1 Modify Concentration of Calibration Gas

c) "**Modify Cal. Gas Concentration**" is displayed on the upper part of the LCD; set values of calibration gas components, which were used during the previous calibration, are displayed in the middle part. If these values do not match the nominal values used for this calibration, user can make modification as follows,

●**S** key—move ⇧ to make it locate at any figure of the 4 channels;

●▲ or ▼ key—modify the value located by ⇧，the value is ranged 0～9;

●**K key**—confirm the modification and enter the interface as shown in Fig. 4-4-2.

d) If the set values for HC、CO and CO_2 match the nominal values on the three-component gas cylinder used for this calibration, or the set values are modified, press [K] in the interface as shown in Fig. 4-4-1 to enter the interface as shown in Fig. 4-4-2. **During calibration with three-component gas, the set value for NO channel can be ignored.**

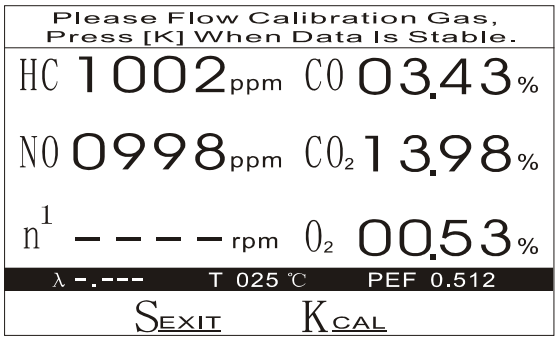
Please Flow Calibration Gas,
Press [K] When Data Is Stable.
HC 1002ppm CO 03.43%
NO 0998ppm CO2 13.98%
n 1 ---- rpm O2 00.53%
λ -.--- T 025 ℃ PEF 0.512
SEXIT KCAL

Fig 4-4-2 Wait for Calibration

e) In the upper part of interface of Wait for Calibration (Fig. 4-4-2), "**Please Flow Calibration Gas, Press [K] When Data Is Stable.**" is displayed. Follow the prompt, flow three-component gas via calibration gas inlet. Press [K] after readings are stable. "**Calibrating HC/CO/CO2...**" appears at the lower part of the display (Fig. 4-4-3)，"**Calibrating HC/CO/CO_2 ... OK!**" will be displayed in several seconds (Fig. 4-4-4)，span of HC、CO and CO_2 channels have been calibrated. The prompts disappear in several seconds and the main menu is returned（Fig. 4-2-1）.

f) If [K] is pressed without flowing standard gas to the instrument or the calibration values are out of range, "**Calibrating HC/CO/CO_2 ... Fails!**" will be displayed at the lower part of the LCD. The prompt disappears in several seconds and the main menu is returned (Fig. 4-2-1), the calibration is invalid.

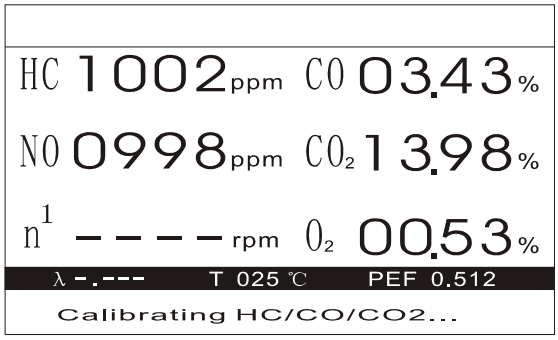

Fig 4-4-3 Calibrating

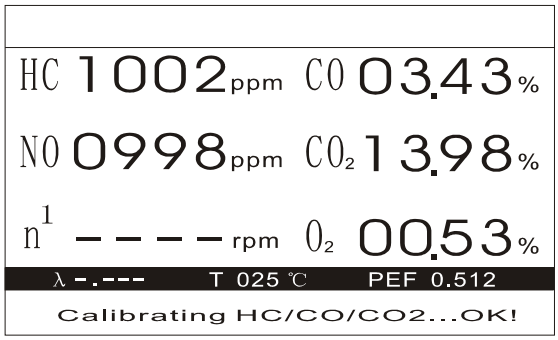

Fig 4-4-4 HC CO CO_2 Calibration OK

g) In the interface of Wait for Calibration (Fig. 4-4-2), if calibration is not required any more, press [S] to return to the main menu directly (Fig. 4-2-1).

h) After calibration, remove the gas cylinder before other operations.

⚠ Note: A check valve is assembled at the calibration gas inlet on the instrument. When flowing calibration gas into the instrument, aim the nozzle of the calibration gas cylinder at the calibration gas inlet on the instrument, slightly force it downward to open the valve, and the calibration gas will enter the instrument.

⚠When using any calibration gas cylinder other than the one supplied by us, if the nozzle of the gas cylinder is inapplicable for this instrument, and the check valve can not be opened, use the adapter in the accessories. To use it, fasten it on the inlet of calibration gas, the check valve will be opened.

4.4.3 Calibrate NO Channel（not for

a) Zeroing: calibrate zero as per 4.3 before span calibration.

b) In the main menu (Fig. 4-2-1), press [▲] or [▼] to locate at **K**GAS CAL, press [K] to enter the interface of Calibration (Fig. 4-4-1).

c) "**Modify Cal. Gas Concentration**" appears at the upper part of the display; the set values of the calibration gas components, which were used for the previous calibration, are displayed in the middle part. If these values do not match the nominal values used for this calibration, user can make modification as follows,

●**S** key—move ⇧ to make it locate at any figure of the 4 channels;

●▲ or ▼ key—modify the value located by ⇧, the value is ranged 0～9;

●**K key**—confirm the modification and enter the interface as shown in Fig. 4-4-2.

d) If the set value for NO channel matches the nominal value on the gas cylinder used for this calibration, or the set value has been modified, press [K] in the interface as shown in Fig. 4-4-1 to enter the interface as shown in Fig. 4-4-2. **During calibration with one-component gas, the set values for the other three channels can be ignored.**

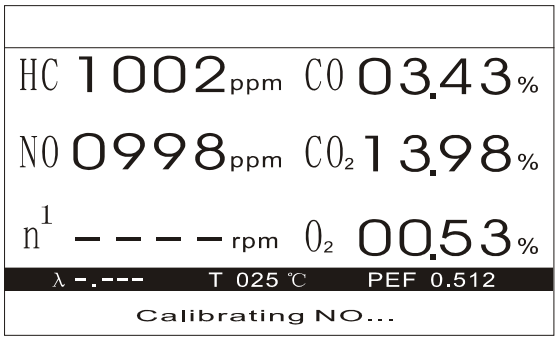

Fig 4-4-5 Calibrating

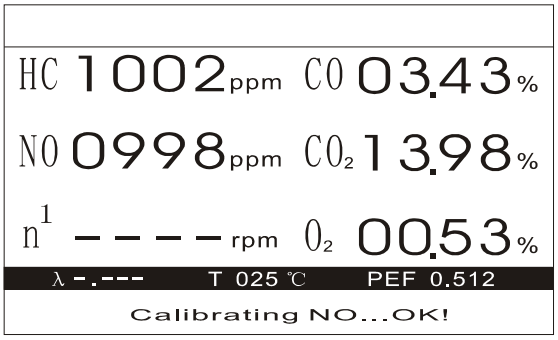

Fig 4-4-6 NO Calibration OK

e) "**Please Flow Calibration Gas, Press [K] When Data Is Stable.**" appears at the upper part of the interface of Wait For Calibration (Fig. 4-4-2). Follow the prompt, flow NO calibration gas via the sample gas inlet (Fig. 3-3, item 6) with pressure of approx. 0.02 Mpa. Press [K] after readings are stable. "**Calibrating NO...**" appears at the lower part of the display (Fig. 4-4-5). The prompt changes to be "**Calibrating NO... OK!**" in a few seconds (Fig. 4-4-6). The span of NO channel has been calibrated. The prompt disappears in a few seconds and the main menu is returned (Fig. 4-2-1).

⚠Flow NO standard gas via the sample gas inlet on the instrument, the flow should be within 5～6L/min. Do not calibrate it without flowing NO standard gas

f) If [K] is pressed without flowing standard gas into the instrument or the calibration value is out of range, "**Calibrating NO ... Fails!**" appears at the lower part of the display. The prompt disappears in several seconds and the main menu is returned (Fig. 4-2-1), the calibration is invalid.

g) In the interface of Wait for Calibration (Fig. 4-4-2)，if calibration is not required any more, press [S] to return to the main menu directly (Fig. 4-2-1).

h) After calibration, remove the gas cylinder before other operations.

4.5 Oil Temperature Calibration

Calibrate oil temperature when it is deemed as necessary. The steps are as follows,

a) Insert oil temperature sensor, wait for 5 min. or above.

b) In the main menu（Fig. 4-2-1），press [▲] or [▼] to locate at "**K<u>T CAL</u>**"，press [K] to enter the interface of Oil Temperature Calibration (Fig. 4-5-1).

c) If oil temperature sensor is not inserted, a prompt "**Install Oil Temp. Probe!**" appears. The prompt disappears in a few seconds and the main menu is returned (Fig. 4-2-1). This calibration is invalid.

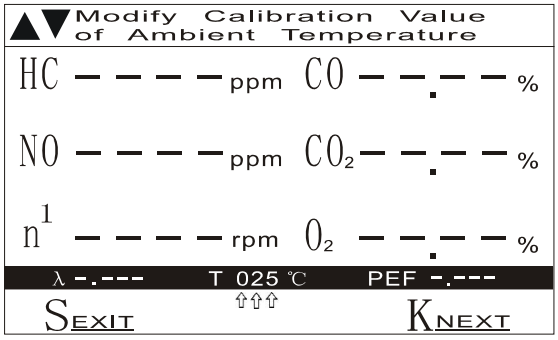

Fig 4-5-1 Setting Calibration Values at Ambient Temperature

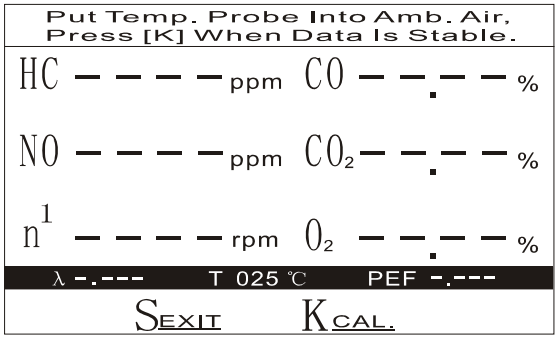

Fig 4-5-2 Wait for Calibration at Ambient Temperature

d) Fig. 4-5-1 shows settings calibration values at ambient

temperature，press [▲] or [▼] to modify the current setting at ambient temperature (subject to the current reading of the temperature measuring device). After modification, press [K] for the next operation（Fig. 4-5-2）. If oil temperature calibration is not required any more，press [S] to exit and return to the main menu (Fig. 4-2-1).

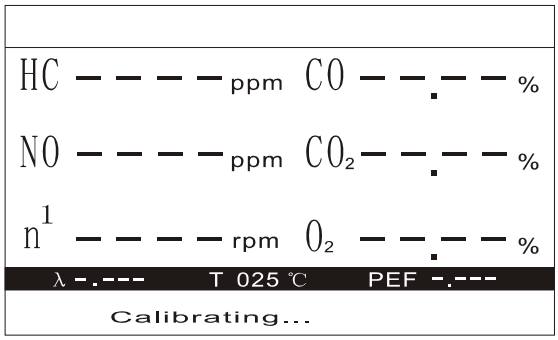

Fig 4-5-3 Calibrating at Ambient Temperature

e) In the interface of Wait For Calibration At Ambient Temperature (Fig. 4-5-2), follow the prompt，place the oil temperature sensor in ambient air, press [K] when the reading is stable, and start calibration at ambient temperature (Fig. 4-5-3). If such calibration is not required, press [S] to skip it and enter the interface of Setting Calibration Values at High Temperature Point (Fig. 4-5-5).

f) After calibration at ambient temperature is completed, "**Calibrating...OK!**" appears at the lower part of the displayed (Fig. 4-5-4). In several seconds, the interface of Setting Calibration Values at High Temperature Point is entered (Fig. 4-5-5). If oil temperature sensor is not inserted or the set values are out of range, "**Cal. Value Out of Range, Calibration Fails!**" appears at the lower part of the display. The prompt disappears in a few seconds and the main menu is entered (Fig. 4-2-1)，this calibration is invalid.

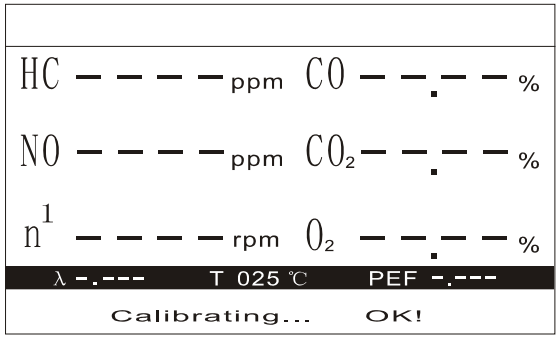

Fig 4-5-4 Calibration at Ambient Temperature Completed

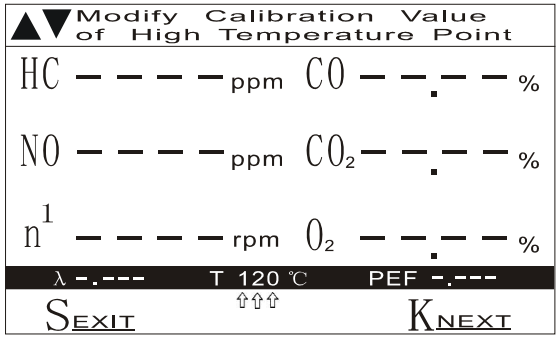

Fig 4-5-5 Setting Calibration Values at High Temperature Point

g) Fig. 4-5-5 shows the calibration values at high temperature point，press [▲] or [▼] to modify the set values at high-temperature environment (100℃ boiled water or other high-temperature device with known temperature）. After modification, press [K] for the next operation (Fig. 4-5-6). If high-temperature calibration is not required any more，press [S] to exit and return to the main menu (Fig. 4-2-1).

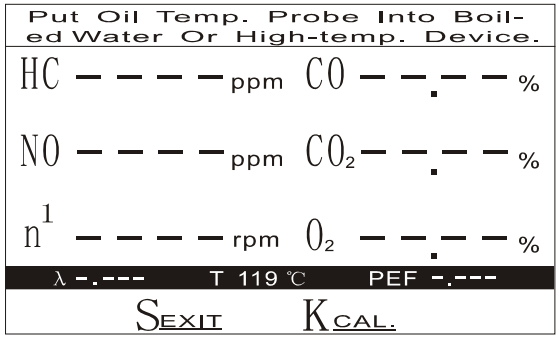

Fig 4-5-6 Wait For Calibration at High Temperature Point

h) In the interface of Wait For Calibration At High-Temperature Point (Fig. 4-5-6), follow the prompt，place the oil temperature sensor in 100ºC boiled water or other high-temperature device with stable temperature, press [K] when the reading is stable, start calibration at high-temperature point. If such calibration is not required, press [S] to exit and enter the main menu (Fig. 4-2-1).

i) After calibration at high-temperature point is completed, "**Calibrating...OK!**" appears at the lower part of the display and the main menu is returned (Fig. 4-2-1). If oil temperature sensor is not inserted or the set values are out of range, "**Cal. Value Out of Range, Calibration Fails!**" appears at the lower part of the display. The prompt disappears in a few seconds and the main menu is entered (Fig. 4-2-1), this calibration is invalid.

4.6 Leak Check

Automatic leak check is done after warm-up (which is related to the setting at 4.7.1). User may run leak check at any time as required, the steps are as follows,

a) In the main menu (Fig. 4-2-1), press [▲] or [▼] to locate at "**SLEAK**", press [S] to enter the interface of Leak Check.

b) Follow the prompts at the upper part of the display, cover the probe with tip cap，press [K]，leak check is done in 10 seconds. if leakage is detected，"**Leakage, Please Check.....**" is displayed. If no leakage is detected , "**Leak Checking .....OK!**" is displayed. The main menu is returned in several seconds (Fig. 4-2-1).

c) If leakage is detected, user should check the whole sampling system carefully and eliminate leakage (see 6.4), otherwise "**Leakage, Please Check.....**"will be always displayed.

4.7 Setting

This sub-menu is for setting fuel type and communication baud. In the main menu （Fig. 4-2-1），press [▲] or [▼] to locate at "**SSET**"，press [S] to enter the interface of **"Setting Menu"** (Fig. 4-7-1).

4.7.1Leak Check at Power-On

In the sub-menu **"Setting Menu"**（Fig. 4-7-1），press [▲] or [▼] to move the cursor ⇨ to item Power-ON Leak Check，press [K] to switch between YES and NO. YES is for automatic leak check at each power-on, NO is for no automatic leak check at each power-on. The default setting is YES.

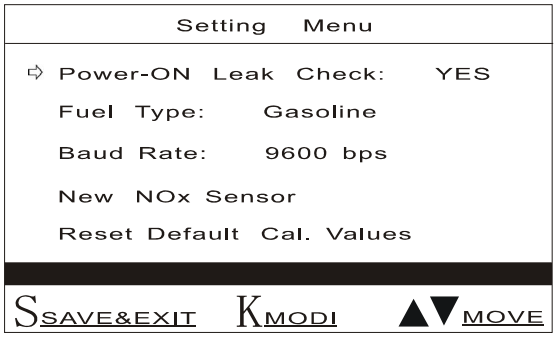

Fig 4-7-1 Setting Menu

4.7.2 Setting Fuel Type

In the sub-menu **"Setting Menu"**（Fig. 4-7-1），press [▲] or [▼] to move the cursor ⇨ to locate at item Fuel Type，press [K] to switch among Gasoline、

LPG、Natural Gas and Ethanol Gasoline.
The default setting is Gasoline.

> ⚠When fuel type is set as "Gasoline"、"Natural Gas" and "Ethanol Gasoline", HC indication represents hexane equivalent, with the mark of "HC"; when "LPG" is set, HC indication represents propane equivalent, with the mark of "C_3H_8".

4.7.3 Setting Baud Rate

In the sub-menu **"Setting Menu"**（Fig. 4-7-1）, press [▲] or [▼] to move the cursor ⇨ to locate at item Baud Rate, press [K] to switch among 300 bps、600 bps、1200 bps、2400 bps、4800 bps and 9600 bps.
The default setting is 9600bps.

4.7.4 Clear Ageing Symbol of NO Sensor

After NO sensor is replaced, clear the ageing symbol of NO sensor and re-calibrate this channel before being used.

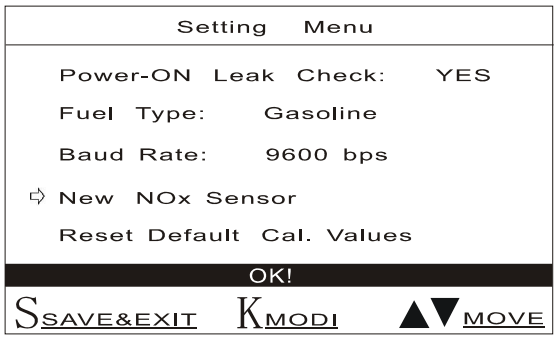

Fig 4-7-2 Clear Ageing Symbol of NO Sensor

In the sub-menu **"Setting Menu"**（Fig. 4-7-1）, press [▲] or [▼] to move the cursor ⇨ to locate at item "New NOx Sensor", press [K] and "OK!" flashes at the lower part of the display（Fig. 4-7-2）, it disappears at several seconds and the sub-menu **"Setting Menu"** is returned（Fig. 4-7-1）.

4.7.5 Reset Default Calibration Value

During calibration, if re-calibration is impossible due to wrong operation and the data is seriously deviated, the default values can be reset in the sub-menu **"Reset Default Cal. Values"**.
In the sub-menu **"Setting Menu"**（Fig. 4-7-1）, press [▲] or [▼] to move the cursor ⇨ to item "Reset Default Cal. Values", press [K], "OK!" flashes at the lower part of the display（Fig. 4-7-3）, it disappears at several seconds and the sub-menu **"Setting Menu"** is returned（Fig. 4-7-1）.

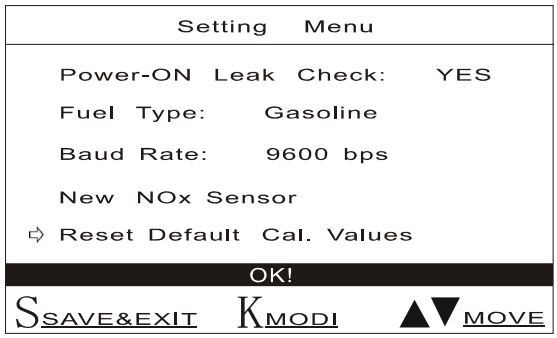

Fig 4-7-3 Reset Default Cal. Values

4.8 Real-time Measurement

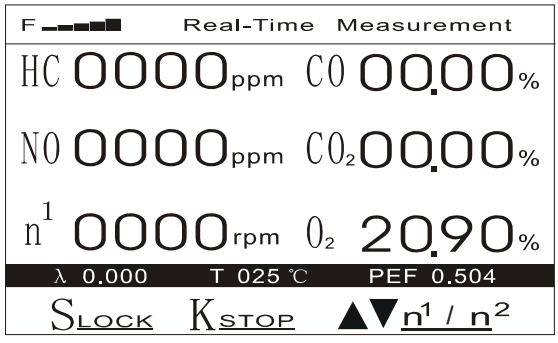

Fig 4-8-1 Real-time Measurement

In the main menu（Fig. 4-2-1）, press [▲] or [▼] to locate at "**KMEAS**", press [K] to enter the interface Real-time Measurement (Fig. 4-8-1).
The upper part of this interface（Fig. 4-8-1）is for name of this sub-menu; the

middle part is for real-time values of HC、CO、CO_2、O_2、NO（Not for NHA-406）、n（RPM）、λ（Excessive air co-efficient）、T（oil temperature）and PEF; the lower part is for prompts. There is a flow indicator on the up left corner，3-5 grids indicates proper flow. 1 grid or no grid represents insufficient flow. When the air path is blocked, the symbol "F" on the left of the flow indicator will flash.（In this case, user shall eliminate it as per the method in 6.2）

After "Real-time Measurement" is started，the pump will be started. Insert the sampling probe into tailpipe of the vehicle being tested for a depth of 400mm. The display shows the real-time values of HC、CO、CO_2、O_2、NO、λ and PEF. If the optional RPM pliers and oil temperature sensor are mounted, the real-time RPM (n) and oil temperature (T) will be displayed.

⚠Engine speed is tested indirectly by using the engine ignition pulse. As there are many engine types and models, the construction and performance vary greatly, the RPM pliers equipped on this instrument is not effective to all the engines, the effectiveness is approx. 80%. If this is not effective to some engines, recommend to use other RPM devices.

⚠The interference to some engines is great. When RPM and oil temperature are measured, due to the interference, the instrument does not work properly because of the slow updating of the measurement data. In such case, try to take out the oil temperature sensor. If the problem still can not be solved, recommend other measuring methods.

4.8.1 Change Engine Ignition

In the interface of Real-Time Measurement（Fig. 4-8-1），figure "1" on the up right corner of the RPM symbol "n" represents single ignition; "2" represents two ignitions. In order to facilitate user to select the ignition correctly and quickly, press [▲] or [▼] in this interface to switch between n^1 or n^2, the real-time RPM values will be switch automatically as per the ignition way.

4.8.2 Lock data and Print Data

During real-time measurement，if real-time value lock-out is necessary, press [S] in the interface of Real-Time Measurement(Fig. 4-8-1), enter the interface of Data Lockout（Fig. 4-8-2）

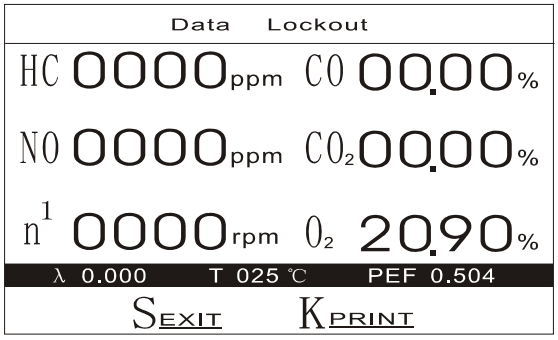

Fig 4-8-2 Data Lockout

In the interface "Data Lockout" (Fig. 4-8-2), all the real-time data can be locked for user to record the current measurement data. If optional printer is equipped, and "COM/Printing" Selector on the rear panel of the instrument (Fig. 3-3, item 4) is switched to "Printing", user may lock the data in this interface (Fig. 4-8-2), press [K] to print the locked data, see Fig. 4-8-3.

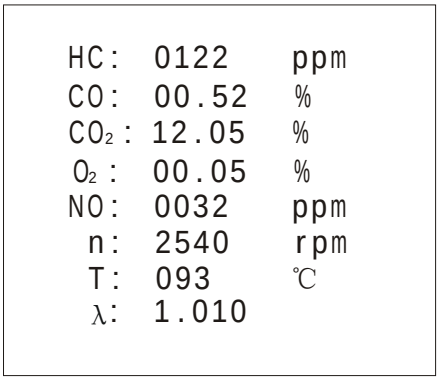

Fig 4-8-3 Print Out

In the interface of Data Lockout（Fig. 4-8-2），press [S] to return to the main menu directly（Fig. 4-2-1）.

⚠For printing data, "COM/Printing" selector on the rear panel must be set to "Printing".

4.8.3 Stop Real-time Measurement

Before real-time measurement is stopped, take out the sampling probe from the vehicle tailpipe. Press [K] in the interface of Real-Time Measurement (Fig. 4-8-1), or press [S] in the interface of Data Lockout (Fig. 4-8-2), real-time measurement can be stopped, stop the pump and return to the main menu（Fig. 4-2-1）.

⚠After measurement is completed and before power is switched off, it is recommended to set the instrument at the status of measurement, The pump will be on for approx. 10 minutes. And place the sampling probe into clean air, let clean air flow into the instrument to blow off the exhaust gas left in the piping.

5 Serial Communication and Protocol

The RS-232 socket (Fig. 3-3, item 3) on the rear panel of the instrument is the serial communication port for connection with the external computer for transmitting measurement data or for other operations. In the interface of Main Menu (Fig. 4-2-1) or Real-time Measurement (Fig. 4-8-1), external computer can communicate data with the instrument.

⚠ For data communication, "COM/Printing" selector on the rear panel must be switched to "COM".

5.1 Connection and Serial Communication Parameter

5.1.1 Connection

RS-232 connection is as show on Fig. 5-1.

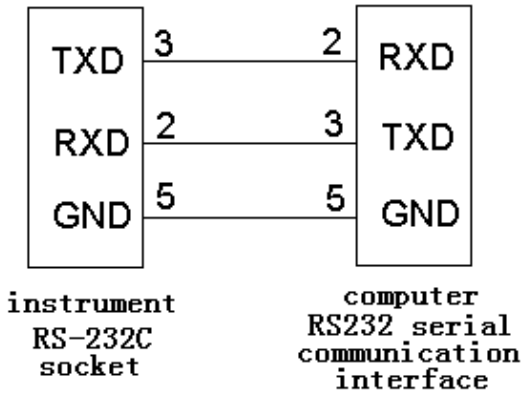

Fig 5-1 RS-232 Connection

5.1.2 RS-232C Serial Communication Parameter

●Baud Rate：9600 Baud; (it is related to the setting in 4.7.3);

●Character Length：1 start bit，8 data bit，1 stop bit；

●Parity: None

5.2 Data Format and Command of Protocol

5.2.1 Pump-on

External computer sends ： 01H（hexadecimal，same for the following commands）

Instrument responds：ACK（06H）

5.2.2 Pump Off

External computer sends：02H

Instrument responds：ACK（06H）

5.2.3 Access Real-Time Data

External computer sends：03H

Instrument responds：ACK（06H），HC，CO，CO_2，O_2，NO，n，T，λ，check sum

5.2.4 Check Instrument Status

External computer sends: 14H

Instrument responds during warm-up and leak-check：48H

Instrument responds during zeroing：5AH

Instrument responds during stand-by (in the main menu)：57H

⚠The instrument doesn't respond any command if it is not at warm-up, leak-check, zeroing or stand-by status.

5.2.5 Set Fuel as Gasoline

External computer sends：06H

Instrument responds：ACK（06H）

5.2.6 Set Fuel as LPG

External computer sends：07H

Instrument responds：ACK（06H）

5.2.7 Set Fuel as Natural Gas

External computer sends：09H

Instrument responds：ACK（06H）

5.2.8 Set Fuel as Ethanol-Blended Gasoline

External computer sends：19H

Instrument responds：ACK（06H）

5.2.9 Set Ignition as Single"

External computer sends：0AH

Instrument responds：ACK（06H）

5.2.10 Set Ignition as Two

External computer sends：0BH

Instrument responds：ACK（06H）

5.2.11 Others

If the above commands are sent during zeroing, warm-up or leak-check, the instrument responds BUSY（05H）.

5.2.12 Data Format

a) ACK：06H，one byte.

b) HC：HC data, integer with symbol (two bytes), high order first, unit as ppm. For example, the measurement result of HC is 1234 ppm, the HC data will be 04D2H. (If fuel type is set as gasoline, natural gas or ethanol gas, it is expressed with n-hexane equivalent; if fuel type is set as LPG, it is expressed with propane equivalent).

c) CO：CO data, integer with symbol (two bytes), high order first, unit as 100 times of percent. For example, the measurement result of CO is 1.23%, the CO data will be 007BH.

d) CO_2：CO_2 data, integer with symbol (two bytes), high order first, unit as 100 times of percent. For example, the measurement result of CO_2 is -0.25%, the CO_2 data will be 0FFE7H.

e) O_2：O_2 data, integer with symbol (two bytes), high order first, unit as 100 times of percent. For example, the measurement result of O_2 is 0.25%, the O_2 data will be 0019H.

f) NO：NO data, integer with symbol (two bytes), high order first, unit as ppm. For example, the measurement result of NO is 15ppm, the NO data will be 000FH.

g) n：RPM data, integer with symbol (two bytes), high order first, unit as r/min (Note: RPM is related to engine stroke).

h) T：oil temperature data, integer with symbol (two bytes), high order first, unit as ℃.

i) λ：excessive air coefficient data, integer with symbol (2bytes)，high order

first, data is increased by 100 times. For example, the measurement result of λ is 1.030，the λ data will be 0067H.

j) Check sum: sum of all the foregoing data from a) to i), integer without symbol (two bytes, high order first, carry abandoned).

Check Sum = 06H + HC + CO + CO_2＋O_2＋NO（Not for NHA-406）＋n + T＋λ

6 Maintenance

6.1 Open Enclosure

Switch off the power supply before opening the instrument enclosure for maintenance or repair with following steps:

a) If optional printer is mounted, follow Fig. 6-1, remove the front cover from the printer with slight force, press the plastic sheets on the two sides of the printer (Fig. 6-2), pull out the whole printer from the instrument enclosure, disconnect the plug connected with the instrument (Fig. 6-3).

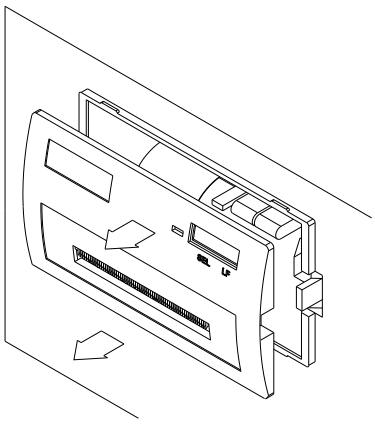

Fig 6-1 Dismantle Front Cover

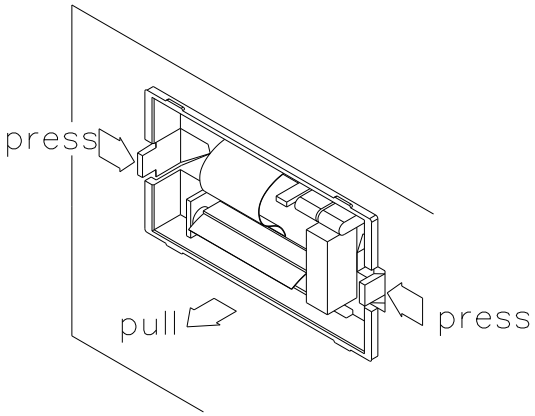

Fig 6-2 Pull Out Printer

b) Remove the four fastening bolts between the casing and the base panel and the two fastening bolts on the rear panel and above the calibration gas inlet. Pull the two side panels outward and pull the casing backward, disconnect the grounding terminal in the enclosure, remove the casing and open the instrument enclosure.

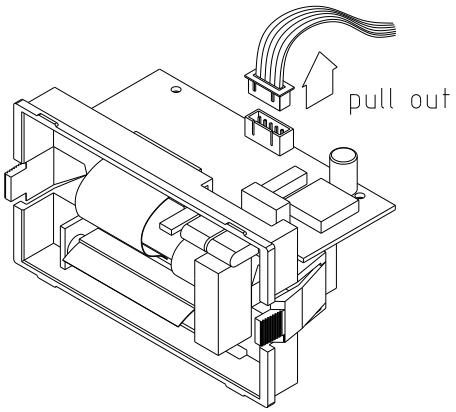

Fig 6-3 Pull Out the Plug

6.2 Replace Filter Elements

In case that the sampling system is clogged by dust, oily mud or any other dirt in emissions, the flow of the sampling system is seriously reduced, the flow indicator on the up left corner of the display will be less than two grids, and the symbol “F” below the flow indicator will flash. Under such circumstance, turn off

the power supply to the instrument, check and clean the sampling probe, sampling pipe and short tube, replace the filter elements of the pre-filter and water filter. After eliminating the clogging, the instrument will work normally.

6.2.1 Replace Pre-filter

a) Uninstall the sampling pipe and the short tube from the failed pre-filter;

b) Take the new pre-filter from the instrument accessories, connect it with the sampling pipe and short tube as per the flow direction arrow marked on the shell, the short tube is connected with the small end of the pre-filter and sampling pipe is connected with the big end. (see Fig. 3-1)

6.2.2 Replace Water Filter Element

As shown in Fig. 6-1, turn the water bowl of the water filter counterclockwise and take it out, loosen and take out the nut, remove the failed small filter element, clamping ring and failed big filter element in sequence, replace them with new ones. Install all the above parts in reverse sequence. Never scratch the surface by hard objects when assembling the new filter elements, otherwise the filtering will be affected. Fasten the nut and the water bowl to prevent any leakage.

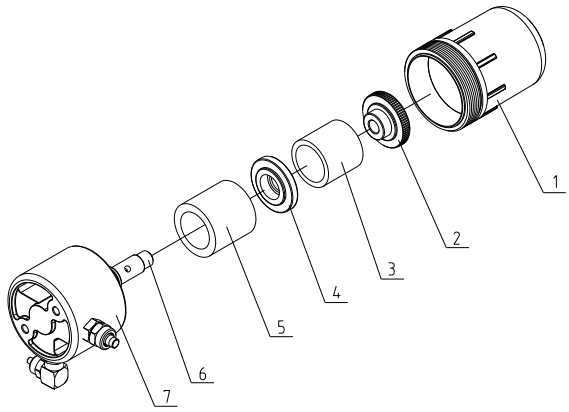

Fig 6-4 Water Filter

- 1——Water Bowl
- 2——Nut
- 3——Small Filter Element
- 4——Clamping Ring
- 5——Big Filter Element
- 6——Bolt
- 7——Base

6.2.3 Replace Zero Gas Filter

The life time of the zero gas filter (Fig. 3-3, item 11) is as long as 2-3 years.
During replacement, remove the failed zero gas filter from the bending pipe connected on the rear panel, install the new one as per the direction marked on the rear panel.

6.3 Replace O2 and NO Sensors

Due to ageing, O_2 sensor and NO sensor need replacement after service for approx. one year, replacement steps follows,

a) Counterclockwise turn the two screws below the sensor caps on the rear panel, see Fig. 6-5.

b) Follow the directions in Fig. 6-6 to open and unload the sensors caps.

c) Disconnect the sensor plugs and remove the failed sensor counterclockwise, as shown in Fig. 6-7.

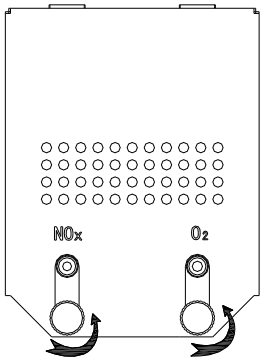

Fig 6-5 Turn the Screws

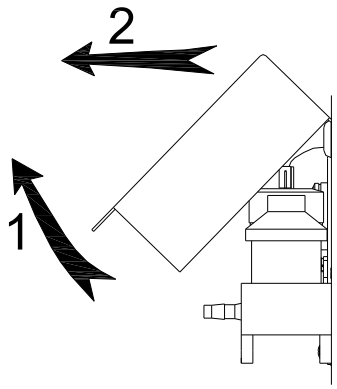

Fig 6-6 Unload the Sensor

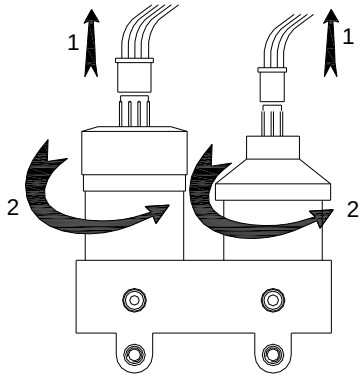

Fig 6-7 Unload the Sensor

d) Rotate the new sensor clockwise and install it in the sensor holder. Be noted to fasten it. O2 sensor and NO sensor can not be installed reversely.

e) Re-insert the plug and close the sensor cap, fasten the two screws on the sensor cap.

f) After O2 sensor or NO sensor is replaced, re-zero as per instructions in 4.3, NO calibration follows 4.4.3.

6.4 Replace Print Paper

Switch off the power supply, follow Fig. 6-1 and Fig. 6-2 to take out the printer, press the two sides of the winding shaft, pull the winding shaft downward and take it out of the printer（Fig. 6-5）. Load the new paper roll on the winding shaft as shown in Fig. 6-6，push the winding shaft upward and load it in the printer. During installing the winding shaft, do not roll the print paper tightly to avoid clamping print paper. Pay attention to the direction of the print paper, only the smooth thermo side can be printed.

Power on the instrument, press [SEL]，the [SEL] indicator is off, press [LF]，the printer feeds paper. Feed the paper manually into the paper entry, paper will enter slowly until the paper comes out the head for approx. 1cm，press [SEL] to stop feeding and the indicator [SEL] is on.

After paper loading, install the printer in the instrument.

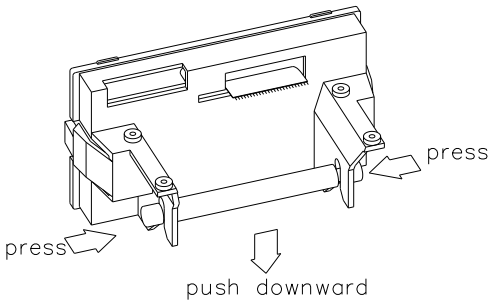

Fig 6-5 Unload Paper Shaft

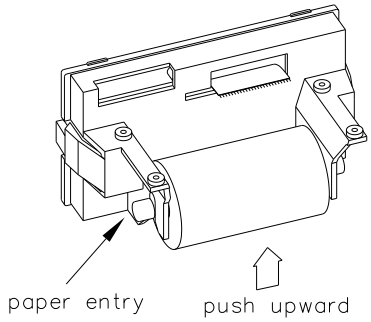

Fig 6-6 Load Print Paper

7 Troubleshooting

Problem	Reason	Solution
Switch on the power supply, the instrument does not work, no display on the LCD.	*The power cable is not connected well; *The fuse is burnt. *LCD is broken.	*Connect the power cable properly; *Replace the fuse; *Contact us to repair LCD.
HC residue is serious. After zeroing and switching on the pump to draw in ambient air, the HC reading is still high.	*Ambient air is polluted; *The concentration of HC contained in the exhaust gases is too high or the measurement time is too long, HC is deposited and attached in the sampling system.	*Place the sampling probe in clean air; *Place the sampling probe in clean air, follow instruction in 4.8 to enter Real-Time Measurement status, then work for some time（approx. 10 minutes），flow in clean air to blow off the residual HC in sampling system. If this does not work, remove the sampling probe and sampling pipe, blow them with compression air. *Replace pre-filter and water filter.（see 6.2） *Contact us to replace the internal piping.
Leak check fails.	*Leakage at the connection between the water bowl and the base. *The sampling probe inlet is not blocked well. *Leakage at the connection of sampling probe. *Poor sealing at the two ends of the sampling pipe or short tube due to ageing. *The sampling pipe is broken or punctuated. *Leakage of the one-way valve. *Accumulator of the pump is broken.	*Check whether the gasket fails or is lost or the connection is fastened, replace the gasket or fasten it. *Block the sampling probe tightly. *Re-connect and re-fasten connection of the sampling probe. *Cut the ageing part or replace it with a new one. *Replace the sampling pipe. *replace the one-way valve. *Replace the accumulator.
The measurement indications of HC、CO and CO_2 channels are zero or very low.	*The sampling probe is not inserted into the vehicle tailpipe. *The pump is broken. *The internal pipes are loosened. *The bench is broken.	*Insert the sampling probe into the vehicle tailpipe properly. *Replace the accumulator or the pump. *Re-connect the pipes. *Contact us to repair the bench.
During real-time measurement, symbol “F” on the left-up corner flashes.	*The sampling system is blocked by dust, oil mud, etc. in the emissions, the flow is greatly reduced.	*Replace pre-filter（se 6.2.1）. *Replace water filter（see 6.2.2）.
The measurement indications of O_2 channel is high or incorrect.	*The O2 sensor is ageing or the service is beyond one year.	*Replace O2 sensor（see 6.3）.
The indication of NO channel varies greatly or the indication is incorrect.	*Wrong NO calibration. *Connection of NO sensor is bad. *The NO sensor is ageing or the service is	*Reset initial calibration value (see 4.7.5）,re-calibrate NO channel（see 4.4.3）. *Re-connect the NO sensor and re-calibrate this channel. *Replace NO sensor（see 6.3）.

	beyond one year.	
Printer does not work.	*Printer and the instrument are not connected correctly. *No print paper.	*Check the connection cable between the printer and the instrument, re-connect and fasten it. Press [SEL] on the printer，the green indicator is on. *Replace print paper（see 6.4）.

⚠**If problems still can not be solved even though the above solutions are tried or other failures are found, please contact the local sales agent or visit *http://www.interequip.com.au* for more details.**